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THIRTY-NINTH ANNUAL REPORT
FOR THE CALENDAR YEAR 1949

- Northern -
Rocky Mountain
Forest & Range
Experiment Station
Missoula Montana

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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

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THIRTY-NINTH ANNUAL REPORT

Foreword

The Northern Region of the Forest Service embraces the headwaters of both the Missouri and Columbia Rivers. It straddles the Continental Divide and extends from the Northern Great Plains across Montana and north Idaho to include six counties in northeast Washington. It is a region of relatively small population, rugged terrain, and great natural resources. Its grazing land is extensive and unexcelled for its productiveness of nutritious forage. Timber of varied species is a major asset offering opportunities for expanded sustained yield production of forest products on a scale unmatched anywhere. The scenery and fish and wildlife resources of the northern Rockies are worth infinitely more in terms of dollar income than is usually recognized, except by the growing number of people who travel thousands of miles every year to get here and share them with us.

But the most important resource of all is water. Twenty percent of the water yield of the Missouri Basin originates on national forest lands which comprise only 5 percent of the total watershed area. Water is of several categories. The few inches of precipitation that normally fall on the plains each year, or the lack of it, means the difference between grass or no grass on extensive areas and all that that involves in terms of the welfare of people. Little can be done to influence the weather. But precipitation that runs off the surface after falling on bare impervious ground is quite as unavailable for plant growth as if it had never occurred at all. So normal rainfall and soil conditions favorable to its ready infiltration and storage are factors of supreme importance throughout the Great Plains country.

Water for irrigation and domestic use is something else again. It is usually derived from streams which have their source in the mountains. Water for power, navigation, and other industrial use is of common origin with irrigation water and subject to the same basis of evaluation and usefulness. It is of importance to many states thousands of miles downstream from the state of origin. If it is burdened with silt it is expensive to use and unsuitable for many purposes. It lays its burden down in reservoirs, thus shortening their life. It costs farmers dollars to keep their canals and ditches unclogged, and it calls for ever higher levy construction and dredging to maintain navigation. Excessive spring runoff entails loss of life and property, and is frequently followed by reduced water flow or dried up streams such as to bring on costs and losses and crises of another character.

Water has been termed the life blood of the West and that is certainly true. It is also true that the usability of that water, its freedom from silt, the regularity of its flow, the very success and permanence

of multibillion dollar dams and other mainstem developments are dependent in large measure upon healthy watersheds. That means watersheds with good vegetative cover and accumulated litter and duff which prevent erosion and permit rain and snow water to enter and fill up the greatest reservoir of all - the soil mantle on the 85 million acres of wild land within the region.

Good watershed management and how to attain it - that is the broad objective of Forest Service Research in the Northern Region. Within that framework we are concerned with how best to maintain and increase the productivity of range land which is needed for livestock and income. What care and management of timber land will assure prompt regeneration after cutting and produce the most and the best wood in the shortest time? What principles and practices should govern our efforts at fire control? What new and improved uses for wood and what manufacturing methods will afford the greatest employment and income opportunities to local people? What is the timber inventory, who owns it, where is it located, how can it best be developed? What is the condition of our watersheds and what land treatment measures are needed to supplement mainstem dams and other installations in the interest of flood control?

These are the questions to which the various research workers of the Northern Rocky Mountain Forest and Range Experiment Station are addressing themselves, and upon which they report in the following pages. They all add up to a watershed management research program, provided, of course, that a good measure of essential integration is secured. We are acutely aware of that need and guard against the work of any division becoming an end in itself. Hence in forest management, for example, when there is a choice of silvicultural practices, the one which best serves the watershed gets the attention. Our forest utilization unit is interested in cheap logging, but concern over what conventional methods sometimes do by way of channeling water and accelerating runoff and erosion has led them to explore and report on alternative systems.

The individual and collective efforts of this station to advance the science of watershed management would be greatly strengthened were it in a position to engage in so-called forest influences studies. From local observation and research conducted elsewhere it is known that vegetative cover has a beneficial influence on the rate of snow accumulation and melt, the capacity of soil to absorb moisture for more gradual release through ground water courses, the stability of soil, etc. But we do not have quantitative data of this character and until we do we cannot know the effect or the tolerances of manipulation of cover through use. This is extremely important in a region which yields so much of the water used and to be used in great developments such as those planned for the Columbia and Missouri Rivers.

DIVISION OF FOREST ECONOMICS

A. Accomplishments in 1949

Forest Survey - Plans

1. A tentative work plan for initiating the Forest Survey project in eight Rocky Mountain states was prepared. This plan, developed in cooperation with the California Forest Experiment Station, presented a four-year program for the forest survey on some 90 million acres of private and public forest lands. Included in the plan were (a) a survey of aerial photo coverage by forest zones, states; and age and scale of photography, (b) a survey procedure aimed at meeting the accuracy objectives of the survey program within the funds budgeted, (c) an organization plan for administering the survey, and (d) a schedule of unit and state reports for summarizing the survey findings.

Forest Survey - Inventory

2. The field inventory phase of the initial survey in eastern Montana was completed. During 1949 field work was carried on in Madison, Beaverhead, Deerlodge and Silver Bow Counties. Some 2.6 million acres of forest land were inventoried. With the completion of eastern Montana, the forest survey project had covered all of the forest area in Region 1 for the first time. Since it was started in 1931 under the direction of M. I. Bradner, the forest survey has covered some 40 million acres of private and public forest land in Region 1. Prior to World War II the work was mainly west of the Continental Divide. From 1946 through 1949 the survey covered 11.4 million acres, all in eastern Montana.

3. Re-inventory work continued in North Idaho. In 1949 2.1 million acres of forest land were covered by the resurvey. Included in this work were Clearwater, Latah, Nez Perce and Lewis Counties. By the end of the year only one county, Idaho, remained to be covered by the North Idaho resurvey. With Northeast Washington completed previously the schedule for the resurvey in Region 1 calls for initiating work in western Montana when North Idaho is finished.

Status of Forest Survey Program in Region 1
(As of December 31, 1949)

Item	Subregional unit				
	E. Montana 1/	NE 2/ Washington	N. Idaho 3/	Montana 4/	Total
1. Type of survey	Initial	Resurvey	Resurvey	Resurvey	--
2. Total forest area (M acres)	11,428	4,002	10,318	14,093	39,844
3. Progress in field inventory (M acres)					
1946 - 1948	8,846	4,002	4,098	--	16,946
1949	2,582	--	2,107	--	4,689
1946 - 1949	11,428	4,002	6,205	--	21,635
4. Percent of field work completed December 1949	100	100	60	0	54
5. Percent of total survey job completed Dec. 1949	84	100	45	0	--
6. Cost of survey from 1946 through 1949 (¢ per acre)	.95	.75	.98	1.13	--

1/ All Montana counties east of the Continental Divide except Fergus, Chouteau, Cascade, and Judith Basin. Also includes Harding and part of Butte Counties, South Dakota, and 1,000 M acres of Yellowstone Park in Wyoming.

2/ Six counties: Ferry, Lincoln, Pend Oreille, Spokane, Stevens, and Whitman.

3/ Idaho north of the Salmon River.

4/ All Montana counties west of the Continental Divide and Fergus, Chouteau, Cascade, and Judith Basin east of the Divide.

Forest Industry Analysis

4. A lumber production survey for 1948 in cooperation with the Western Pine Association showed the highest production since 1925. Each year since 1945 lumber production in Region 1 has increased; the sharpest increase was from 1947 to 1948 when records show that production went up 18 percent. In the four-year period 1945-1948 lumber output in the region has gone up 51 percent. The following table shows lumber production for the four post-war years.

The lumber production trend in Region 1 - 1945-1948

Subregion	Production by years and percent change					
	1945	1946	1947	1948	Change 1947-1948	Change 1945-1948
	Million ft. b.m.				Percent	
NE Washington	141	182	208	269	+29	+91
North Idaho	611	630	689	786	+14	+29
Montana	342	415	500	598	+20	+75
Northern Region	1094	1227	1397	1653	+18	+51

5. The station continued its analysis of pole production as part of the timber drain work of the forest survey. Production data were obtained from all pole plants in the region with the assistance of the Rocky Mountain Pole & Treating Association. Similar data were collected in 1946 and 1947. The trend of production by species is shown in the following table:

Pole production by species and years - Region 1

Species	Number of poles produced		
	1946	1947	1948
Lodgepole pine	340,048	351,310	138,099
Western redcedar	245,310	230,872	212,785
Western larch	111,540	221,990	90,879
Douglas-fir	12,419	6,473	5,419
Miscellaneous	1,144	6,557	804
Total	710,461	817,202	447,986

The sharp drop of 45 percent from 1947 to 1948 reversed the post-war trend of rising production. Significant factors influencing the low production in 1948 were the uncertainty of markets and changes in buyer specifications.

6. For the first time the station assembled comprehensive data on pulpwood production. This was released in Research Note 73, entitled, Pulpwood Production on the Increase. Region 1 has one small pulpmill operating at Spokane, Washington. A second pulpmill is being constructed at Lewiston, Idaho. Two other mills are under consideration, one in Idaho and one in Montana. Some 40,000 cords of lodgepole pulpwood were shipped from Montana to Wisconsin during 1948. Because of the plentiful supply of wood for pulp in this region there is an increasing interest on the part of a number of companies in building pulpmills in this area. In view of these developments the station has initiated annual summaries of pulpwood production as a part of the forest survey drain work.

Forest Resource Analysis

7. Forest Resources of Southern Montana was the title of the second report released covering progress on the initial survey in eastern Montana. (Station Paper 20.) This report gives timber volume and forest area data for 15 southern Montana counties. In this unit there are 24.6 million acres of land, 10 percent of which was classified as forest land by the forest survey. Three fourths of the forest land is considered as having commercial possibilities, whereas the remainder is so remote and inaccessible, or withdrawn from commercial use for parks and wilderness areas, as to be classed noncommercial. Altogether on the commercial forest area there is slightly more than four billion board feet of saw timber. Very little use is being made of this timber. Only a few small sawmills exist throughout the area and these produce mainly for local use.

8. Findings of a resurvey of the forest situation in Northeast Washington were released. Station Paper 21, entitled, Forest Resources of Northeast Washington, gave an indication of the 13-year trend from 1935 to 1948 in stand composition and timber volume.

   From the comparison one factor is outstanding: The sizeable decrease in the saw-timber volume of western white pine. The volume of this species went down 48 percent, from 797 to 418 million board feet. Increases in the volume of other species such as Douglas-fir, grand fir, alpine fir, western hemlock and lodgepole pine were enough to offset the decrease in white pine so that the total saw-timber volume for Northeast Washington increased 3 percent. The sawmill industry in this area has historically been dependent on white pine for its profit margin. With the white pine supply declining the industry faces the problem of finding and maintaining profitable outlets for the less valuable species.

CHANGES IN NORTHEAST WASHINGTON FOREST RESOURCES

Saw-timber volume by counties

County	1935	1948	Change
	Million ft., Int. 1/4" rule		Percent
Ferry	5,640	6,614	+17
Stevens	4,287	4,446	+ 4
Pend Oreille	3,177	2,608	-18
Spokane	1,208	1,033	-14
Lincoln	98	162	+65
Whitman	--	28	--
Total	14,410	14,891	+ 3

Saw-timber volume by species

Species			
Western white pine	797	418	-48
Ponderosa pine	5,607	5,582	- 1
Western larch	2,945	2,533	-14
Douglas-fir	3,918	4,696	+20
Other species	1,143	1,662	+45
Total	14,410	14,891	+ 3

Commercial forest land area

Stand-size class	1935	1948	Change
	- - - - - -M acres- - - - -		Percent
Saw timber	1,321	1,288	- 3
Pole	1,182	1,227	+ 4
Seedling-sapling	963	847	-12
Deforested	278	346	+24
Total	3,744	3,708	- 1

9. During 1949 a rough draft of the report, Forest Resources and Industries of Montana, was completed. The report is one of a series being prepared for nearly all of the states in the Nation upon the completion of the initial forest survey. In addition to presenting the salient statistics and forest facts the report discusses the place of the forests in Montana's economy, the industrial situation, and the problems involved in obtaining full and stable development of the timber stand in this state.

One of the outstanding features of the Montana situation is the extensive area of mature timber yet to be opened up. Full development of this timber will require a great expansion of the forest road network, much more intensified protection against insects, and a broader industrial base to utilize material now marketable to only a limited extent.

Economics of Forest Management, Utilization, and Marketing

10. A study of Christmas tree marketing in Montana, begun during the Christmas tree season of 1948, was completed in 1949 with the preparation of two reports. The first of these, Suggested Montana Douglas-fir Christmas Tree Standards (Station Paper 18), analyzes the technical feasibility of Christmas tree grading. The authors of the report conclude that it is feasible to grade trees. The following grading rules are suggested:

PROPOSED GRADES FOR
MONTANA DOUGLAS-FIR CHRISTMAS TREES

Factor	Each grade must possess the indicated characteristics			CULL
	No. 1 Premium	No. 2 Standard	No. 3 Utility	Any one of following factors will cull a tree
DENSITY	Medium or denser	Medium or denser	Light or denser	Open
TAPER	Normal or wider	Normal or wider Candlestick if tree is otherwise grade No.1	Normal or wider Candlestick if tree is otherwise grade No.2	Candlestick if tree is otherwise grade No.3
BALANCE	4 complete faces	3 or more complete faces	2 or more complete faces	3 defective faces
FOLIAGE	Healthy	Healthy	Infected or healthy	Blighted
DEFORMITY	Minor	Minor Noticeable if tree is otherwise grade No.1	Minor Noticeable if tree is otherwise grade No.2	Major Noticeable if tree is otherwise grade No.3

This report and the proposed grading rules in it have aroused considerable interest in the industry. As yet no one has pointed out any important weakness in the rules.

The second and more comprehensive report, Marketing Montana Christmas Trees, was completed during the year and is to be published by the Montana State University. It will be one of a series of three bulletins to be produced jointly by the Montana State University and this station. The first of the series deals largely with a description of the production process and costs and returns aspects of the Christmas tree business. The third bulletin, which will not be issued for several years, is to discuss the techniques of Christmas tree management and will be based on studies now in progress. The marketing report points out that the biggest problem of the industry is the poor quality of a large proportion of the trees shipped out of the state, a factor which in the long run will have an adverse effect on the competitive position of Montana trees. Strengthening of the grower associations, adoption of grading rules, and trade promotion are recommended to help cope with the situation.

B. Plans for 1950

Forest Survey - Plans

1. Consideration is being given to initiating a resurvey of the forests of South Dakota. During 1950 some material will be assembled on aerial photo coverage and the availability of other basic material. If funds are allotted for the South Dakota resurvey a detailed plan will be developed and aerial photographs will be purchased.

Forest Survey - Inventory

2. The resurvey work will be continued in North Idaho. Field work is planned for Idaho County. This will involve establishment of 250 semipermanent volume and growth and drain plots. Generalized type mapping for all forest land is planned for approximately 2 million acres.

3. In South Idaho the initial survey may be started in a four-county block — Bannock, Bonneville, Madison, and Teton. A preliminary estimate indicates that these counties have approximately one-half million acres of forest land and a total land area of about 3 million acres. Because of the number of survey problems presented in Region 4 the survey work in these four counties will be largely of an explorative nature, testing various procedures and methods that are most economical in this type of forest.

Forest Industry Analysis

4. A study of timber cut for mining is planned as part of the forest survey work. This study is scheduled to cover all of Region 1 and will include obtaining data on timber use by all of the large mines and some of the smaller ones.

5. A survey of pole production will be conducted in cooperation with the Rocky Mountain Pole and Treating Association. This survey will provide data on timber drain resulting from pole production.

6. Pulpwood production will be summarized as was done in 1948.

Forest Resource Analysis

7. A station paper, entitled Forest Resources of South Central Montana, is scheduled for release. This will be the third statistical report from the initial survey of eastern Montana and will cover 9 counties.

8. The manuscript of the report, Forest Resources and Industries of Montana, will be edited and revised during 1950. The manuscript will be submitted then for final review and subsequent publication as a U.S.D.A. publication.

Economics of Forest Management, Utilization, and Marketing

9. The manuscript, Marketing Montana Christmas Trees, will be published by the Montana State University. This will be the final publication from the Christmas tree project initiated in 1947 by this division.

10. A study to analyze the feasibility of pulpmills in eastern Montana will be started in 1950. As laid out in the work plan the purpose of this study is to clarify some of the factors relating to the feasibility of a pulp industry in eastern Montana and to provide some of the facts and figures necessary for guiding sound forest development in this locality, with particular reference to the national forests. The study will be limited in its field. Such matters as the profitableness of a Montana pulpmill in comparison with plants elsewhere and the competitive difficulties likely to be experienced in marketing pulp and paper made in Montana are beyond the present capacity of the experiment station. Attention will instead be directed mainly toward those factors relating to the adequacy, suitability, and operability of the timber resource.

DIVISION OF RANGE RESEARCH

A. Accomplishments In 1949

Artificial Range Reseeding

1. One crop of spring wheat or barley, averaging 10 to 15 bushels per acre, will pay for the conversion of cheatgrass to crested wheatgrass on abandoned-plowed rangelands and return a fair additional profit. A cost-return analysis of the preparatory crop method as applied on cheatgrass infested, range land on the Antrim ranch which was completed in 1949 has shown that the gross return from 585 acres averaged $19.14 per acre or $4.55 above total costs. Costs of machine operation, labor, seed, fence construction, loss of grazing value during an 18-months period and interest were balanced against the dollar value of one grain crop and one year of improved grazing following establishment of the crested wheatgrass stand. Susceptible to application of the results of this study are a high percentage of the vast acreages of cheatgrass range land in the upper Columbia basin and the 1.5 to 2.0 million acres of cut-back wheat acreage in Montana, most of which lies in the upper Missouri basin.

2. The off-set disk was proven as an effective tool for removing big sagebrush from deteriorated range lands to be reseeded. Tests completed during the year in cooperation with the Beaverhead National Forest showed that the off-set disk could be used on relatively rock free slopes up to 30 percent and that about 75 percent of a dense stand of big sagebrush could be removed in one trip over the ground. Simultaneously, a satisfactory seedbed for forage species was prepared. These results indicate the possibilities of using this tool in the conversion to productive range of vast acreages of big sagebrush which occur throughout the upper Missouri basin.

3. Adaptability of the Ford-Ferguson tiller, drawn by a wheeled tractor, to seedbed preparation on weed infested mountain ranges was successfully demonstrated in co-operative studies conducted on the Bitterroot National Forest. A thorough job of reducing weed competition was done at nominal cost on steep; fertile soils to be re-seeded. Many small, deteriorated areas capable of high herbage production occur throughout the upper Columbia and upper Missouri basins. These results show that re-seeding can be done using ordinary farm equipment with good chances for success.

4. The justification for reseeding research and the many aspects and values of species adaptability tests as the first step in a well-rounded program were explained to 150 Montana University students in plant ecology at the Antrim area. The area was also visited by the Montana conservation caravan and the objectives and accomplish-ments explained to its members.

Management of Summer Ranges

5. Fire, properly handled, is a cheap, effective means of removing big sagebrush from range lands. However, sage-brush may regain control of the range in a few years. A sagebrush range near Dell, Montana, burned in 1947 is now again heavily infested with sagebrush. Important perennial grasses are more vigorous but less dense than before burn-ing. Low-value weeds are still more numerous than formerly. These results indicate that sagebrush burning alone is not a sound range improvement practice.

Management of Short-Grass Ranges

6. Two-thirds of an acre of good short-grass range per month or 5.4 acres for an eight-month season beginning in March is adequate over the long pull for normal development and maintenance of a dry yearling ewe. This is just one of the guides to proper management of northern Great Plains sheep range contained in U.S.D.A. circular 804 published in April 1949. The circular presents a store of new information concerning short-grass range vegetation and soils and how these are affected by sheep grazing. Some of the grazing and other habits of range sheep and how they relate to management systems are also treated. The circular is timely and valuable especially in view of the vast acreage of short-grass rangeland which lies within the Missouri River basin.

7. Range calves raised to weaning on moderately and lightly stocked range remain heavier than calves from heavily stocked range at least up to 18 months of age even though they are all wintered alike and grazed together on good range lightly stocked the second summer. A manuscript, produced cooperatively by the Division and the Bureau of Animal Industry and published as Montana Agricultural Experiment Station Bulletin #463 in August 1949, shows that during an 8-year cattle grazing study, calves from moderately and lightly stocked range weaned 28 to 33 pounds heavier than calves from heavily stocked range. This set-back in body weight persisted to 18-months of age and was not overcome even though the calves were well handled and properly cared for. Considered either from a financial standpoint or as a factor in selecting replacement cattle the results point to the necessity of providing ample range forage for cows and calves.

8. The natural relationship between heights of bluestem wheatgrass plants growing within and outside pricklypear clumps on the same site and how that relationship is affected by intensity of grazing use may be valuable criteria in judging range condition and trend in the northern Great Plains. A study of this relationship has been conducted through two field seasons. In 1948, a better than average rainfall year, plants growing outside cactus clumps were 92 and 74 percent as tall on lightly and heavily stocked range, respectively, as plants protected by the cactus. Last year severe drought reduced plant heights generally but relationships of 91 and 72 percent were found between protected and unprotected plants on the same two ranges. The occurrence of drought unexpectedly gave a valuable test of the relationship. Simple estimates of range condition may be possible with this method where pricklypear is present. Repeated after a period of years the estimates should indicate range trend.

9. The justification for range management and reseeding research in the northern Great Plains and its practical application were explained to over 300 stockmen, students, and technicians in 12 organized groups. Many other visitors received similar information individually.

Noxious Range Plant Control

10. Klamath-weed infestations are known in seven of the eleven western range states and in the six northeasternmost counties of Washington. Over 60,000 acres of once productive range land have been taken over by this troublesome plant. According to estimates gathered during the past year the affected area is growing rapidly and further reductions in range grazing capacity can be expected before effective control measures can be developed.

11. Borascu, a semi-refined borate ore, applied as a soil sterilant at the rate of 4 pounds per square rod is effective in controlling the spread of Klamath weed but under range conditions is prohibitive in cost. In large-scale demonstrations of known techniques, started during the past year, costs ranged from $25 to $35 per acre. Of the total, $18 to $22 is for borascu and its application and $3 to $8 for necessary follow-up reseeding. Miscellaneous costs make up the remainder.

12. The growth processes, especially flowering and seed production, of tall larkspur, a poisonous plant on late spring and early summer mountain ranges, are quickly disrupted by the application of 2, 4-D sprays. In a new study initiated on the Sheridan District of the Beaverhead National Forest in cooperation with the district ranger and forest supervisor, 2, 4-D in water at 2,000, 4,000, 6,000, and 8,000 parts per million caused extreme curling of flower stalks, and severe wilting and drying of flowers, leaves, and stems within a week after application. Final evaluation of the effects of these herbicide sprays will come during the 1950 growing season.

B. Plans for 1950

Artificial Range Reseeding

1. Species adaptation trials will be continued at the Antrim and Big Coulee ranch areas as well as at Miles City, and at two locations in northeastern Washington with emphasis on:

(a) Determination of relative requirements of individual species for growth and reproduction.

(b) Development of a method for analyzing and categorizing range sites to be reseeded.

2. Tests will be made, as opportunities arise, of various types of commercially available machines that may be useful in seedbed preparation and removal of competing vegetation. This phase of the methods line project will be conducted on large-scale pilot or range plantings in cooperation with the National Forests.

3. A cereal crop will be planted on 30 acres of replowed cheatgrass range near Republic, Washington, in preparation for the establishment this fall of 5 promising forage species on a pasture basis. This will lay the base for cattle grazing trials designed to compare the productivity and other features of reseeded range with cheatgrass infested land.

4. The establishment on a pasture basis of several promising range forage species is planned at the Big Coulee ranch for the determination of grazing values for sheep.

5. Familiarity with and understanding of the region-wide reseeding situation will be gained through travel and observation and by close association with National Forest Administration personnel on the ground. This effort is pre-requisite to the project analyses and plans which must be completed as guides to a worth-while, productive, long-range program in artificial range revegetation.

Management of Summer Ranges

6. Compare the performance of driven cattle with cattle of similar class and grade that are hauled by truck to and from National Forest summer range. A study is planned in connection with the grazing of the Vigilante Experimental Range which is expected to reveal the benefits, in cattle weights and gains, of truck hauling to and from National Forest range. Trail driving is now practiced with resulting heavy losses in shrinkage and death of animals. Installation of a livestock scale at Vigilante makes this study feasible.

7. Complete the analysis and reporting of data gathered last year comparing the condition of spring-summer ranges in southwestern Montana that have been used for a number of years under (a) National Forest management, and (b) experimentally controlled stocking with similar areas that have been protected for 9 to 25 years.

8. Develop work project plans for Vigilante giving careful attention to National Forest Administration needs and keeping in mind the need for integration of such plans into the over-all Upper Missouri plan and project analysis of the future.

Management of Short-Grass Ranges

9. Bring up to date by revision and development, range problem analyses for the northern Great Plains and project working plans for the Northern Great Plains Research Center to provide the necessary basis for a long-time research program.

10. Revise and re-orient range-pasture grazing studies at Miles City to more objectively attack range and livestock problems of high priority. This involves: (a) the appraisal of existing vegetation and soil conditions in the pastures which have resulted from past weather and grazing use, (b) the establishment of sampling and other study methods on the ground for future reference, and (c) the inauguration of a handling system which will return heifer offspring at breeding age to the experiment at the same stocking level to which their mothers were subjected.

Noxious Range Plant Control

11. Continue to study the effect of herbicide sprays and mechanical disturbance on the growth processes of Wyethia. The effort is aimed at the control of this low-value plant which has infested large areas of National Forest range in southwestern Montana. In connection therewith, preliminary surveys of the extent of infestations on the Sheridan district of the Beaverhead National Forest and the sites, soils, and range types involved will be made as a basis for ecological investigations.

12. Provide follow-up on studies of control of larkspur initiated last year and examine as many as possible of the larkspur areas sprayed by Beaverhead personnel in 1948.

13. Continue studies in control of Klamath weed in northeastern Washington using borascu as a soil sterilant followed by range reseeding.

DIVISION OF FOREST MANAGEMENT RESEARCH

A. Accomplishments in 1949

1. The Station continued to help develop public understanding and united effort by research institutions and forest managers for study of serious tree diseases.

(a) Pole Blight is now generally recognized as a serious threat to western white pine, the most valuable tree of the Inland Empire, as a result of previous and continuing efforts by the Station and cooperating agencies. Following the pattern set in 1948, the Station held an annual pole blight planning meeting early in the spring. Agencies which were represented included the University of Idaho; Bureau of Entomology and Plant Quarantine; Bureau of Plant Industry, Soils, and Agricultural Engineering; National Forest Administration; and others. For the first time, the Dominion Laboratory of Forest Pathology in British Columbia sent representatives to the conference. Plans were made for the summer which insured coordination of efforts among all institutions. Throughout the year, the Station continued to assist in numerous ways to step up research and interest in pole blight. Specific major contributions included the following:

1. Two one-day pole blight recognition schools for public and private foresters, Deception Creek Experimental Forest, jointly with the University of Idaho and Bureau of Plant Industry, Soils, and Agricultural Engineering.

2. Aid to pole blight project workers and visitors in locating pole blight affected stands.

3. Initiation of a series of three experimental control plots of from 20 to 40 acres each, in cooperation with staff of Kaniksu National Forest and Division of Forest Pathology.

4. Numerous conferences with cooperators and interested forest managers.

5. Preparation of a booklet, "Pole Blight, This is How to Recognize It," in cooperation with the University of Idaho and Bureau of Plant Industry, Soils, and Agricultural Engineering.

The University of Idaho, a major contributor to pole blight research efforts, in addition to preparation of monthly progress reports for all agencies, is preparing several special reports, but the cause of and measures to control pole blight are still unknown.

(b) Dying of ponderosa pine in Spokane and vicinity has caused much concern to the Spokane City Parks Board and owners of residential property on which ponderosa pine is the principal tree cover. Almost two years ago, people began asking Station members and representatives of other public agencies about the unhealthy and dying trees and what could be done to prevent the injury. Early in 1949, the Station made a rough survey to determine the location and extent of the damage. Ponderosa pine was affected to some degree over an area of about 150 square miles.

The Station took the lead in organizing a meeting of interested people to see what could be done about determining the cause. This meeting led to organization of a Spokane Pine Damage Committee which, in turn, asked Washington State College to study the problem, with the Bureau of Entomology and Plant Quarantine to handle insect aspects. This committee also raised funds to finance the project. Subsequently, the Station aided Washington State College on the project by a study of growth of damage trees, dated to climatic records. Several possible causes have been suggested. Fluorine from an aluminum reduction plant and a scale insect have received the most attention. Research has been pursued vigorously by Washington State College.

2. In 1949, the Station engaged one of the nation's leading forest soils authorities, Dr. T. S. Coile of Duke University, to make a preliminary survey of regional forest soils problems and advise how best to begin research. Dr. Coile spent five weeks in the region during August and September, 1949, and will return in 1950 to complete his examinations and offer his counsel. This first step should be of service to agencies engaged in basin development planning in the Northwest and to forestry schools who are beginning study of soils problems, as well as to the Station's forest and range management research divisions.

3. The Station compiled a comprehensive bibliography on the silviculture, management, and protection of ponderosa pine. Ponderosa pine, the most widely distributed and most widely cut of the commercially valuable western pines, has been much studied and much written about. In order to assist forest managers, students,

and scientists in finding and using published information on ponderosa pine, the Station compiled a list of 687 titles and indexed them by subjects. Although released as a Station Paper under a 1950 date, the bibliography is properly regarded as a 1949 accomplishment. It was a big job. It stands as a Station contribution to many and diverse uses, including management of one of the most important natural vegetational resources of all the great western river basins.

4. The Station continued to search out and report information useful to forest managers and to convey this information to them through brief reports, conferences, and field meetings. Among the services rendered during the year, the following are believed to be the more important to better timber and watershed resource management:

(a) Analysis of growth rate records for understocked and overstocked western white pine as compared to growth in normally stocked stands. Most forests are overstocked or understocked. Prediction of the growth to expect from such stands is a troublesome problem to managers. The study, which was based on 10- to 20-year records of 54 plots, showed that understocked stands tend to gain and overstocked stands tend to slow down. For example, a stand which is 60 percent stocked in board feet, in comparison with a normal stand, will gain about 7 percent in five years. In other words, after five years it will be 67 percent stocked. Correction factors which can be applied to normal yield tables were developed. The study also showed that the central values which the under- and overstocked stands approach are not exactly the values given in the yield tables. Scribner board-foot volume stocking tends to approach 88 percent of normal, basal area tends to approach 92 percent, and cubic-foot volume 98 percent. It appears that the white pine yield table values may be somewhat too high.

Upon completion of the analysis, some of the findings were put to use immediately by the Office of Blister Rust Control in disease surveys. Reports will be prepared early in 1950.

(b) Studies of ponderosa pine seed production and dissemination and the effects of improvement of seedbed condition on logging areas. Seed caught in seed traps during dispersal of the heavy 1948 crop showed that seed trees must be evenly and rather closely spaced to insure satisfactory distribution of seed. Ponderosa pine seeds, which

are relatively large for conifer seeds, usually do not blow far from the parent tree. About 12 seed trees per acre, well distributed, seemed to be needed to get adequate reproduction on the 11 areas studied.

In another phase of this project, studies of improvement of seedbed conditions by scarification of the forest floor were conducted in cooperation with the staff of the Kootenai National Forest. Where mineral soil had been exposed by dozer-operated slash pilers, skidding, and road construction, about eight times as many seedlings became established as on the natural forest floor. The Station's biologist from the Fish and Wildlife Service investigated small mammal populations and destruction of seed by small mammals in conjunction with the same studies in order to help round out knowledge of factors affecting regeneration of ponderosa pine. More studies will be required, in other places, and with differing weather conditions before generalized conclusions and recommendations can be made. However, preliminary reports will be prepared early in 1950. They will point out opportunities for application to management.

(c) Experiments with sale area betterment and slash disposal measures on lodgepole pine clear cuttings. During 1949, the Station began installation of a series of 24 two-acre plots on newly cut-over lodgepole pine land on the Lewis and Clark National Forest. The primary object is to discover methods for promptly regenerating lodgepole pine. Important secondary objects are to (1) learn how the various slash disposal methods used in conjunction with natural regeneration measures will meet fire protection needs, and (2) learn how the logging, natural regeneration, and slash disposal methods affect infiltration of water into the soil. In addition, the effects upon soil stabilization of seeding grass and scattering slash in skid roads are being observed.

Preliminary examinations showed that lodgepole pine generally had restocked satisfactorily except where slash had been burned. Burned surfaces occupied a high proportion of the cut-over areas because the established slash disposal practice is to broadcast burn the windrows where the tops have been felled between the skidroads. The following tabulation of reproduction found on an area logged in 1946, on which the slash was burned in 1947, is illustrative:

	Percent of total area	Percent of mil-acre quadrats stocked	Seedlings per acre
Natural forest floor	34	59	3748
Burn	66	9	91

In an adjacent check area where slash had not been burned, the following was found:

	Percent of total area	Percent of mil-acre quadrats stocked	Seedlings per acre
Natural forest floor and light slash	69	58	1207
Skidroads	7	25	1162
Heavy slash	24	14	349

Obviously, burning the slash in windrows severely sets back reproduction. Hand piling, to reduce the burned area is prohibitively expensive. Leaving the slash untouched is generally regarded as too great a fire risk. In the tests now being started, machine piling is being tried as one means of reducing cost of slash piling. The actual fire risk of unpiled slash and its rate of deterioration are also being studied. The National Forest staff is giving much help in the studies. Regional Office personnel from several divisions, as well as members of several Station divisions are giving advice in various specialist subject matter fields such as fuel risk rating, grass seeding in skid roads, and measurement of water infiltration. Establishment of the plots will be completed in 1950.

(d) An analysis of the profits from pruning trees of different sizes. Two species, western white and ponderosa pine, were included in the study. It was found by a study of pruning cost records, current lumber values by grades, and comparison of the quantities and grades of lumber which pruned and unpruned trees can be expected to yield, that trees should be pruned while they are relatively small. The importance of size when pruned is shown for white pine in the table following. Ponderosa pine gave very similar results.

Increase in lumber values 1/ for pruned butt logs, after deducting cost of pruning.

D.b.h. of tree when harvested	Age when harvested	Additional value per MBM when d.b.h. of tree 2/ at time of pruning is approximately---		
		4 inches	6 inches	8 inches
Inches	Years	Dollars	Dollars	Dollars
11	55	0.00	0.00	0.00
13	65	29.56	0.00	0.00
16	80	42.51	20.45	0.00
21	115	48.56	30.09	15.86
27	160	51.96	38.64	30.73

1/ Based on September, 1949, lumber prices.

2/ Assumes pruning in three stages; first to a height of about 9 feet when d.b.h. is 4 inches, and later in two more steps to one full log length before diameter inside bark exceeds 4 inches at the place of pruning.

A manuscript reporting the results has been submitted to a western timber industry journal.

(e) An investigation of sample tree measurement for application on timber sales. Analysis was completed in 1949 and a preliminary report submitted to field officers. It was concluded from the study that (1) sample tree measurement is possible and practicable; (2) generally, sampling should be confined to operations involving from 1,000 to 2,000 trees or more; (3) usually the sampling techniques should include a complete tally of all larger trees (about the upper 10 percent) because these trees contribute heavily to the total volume; and (4) on the basis of admittedly inadequate cost figures, it is estimated that savings may amount to 10 to 15 cents per tree as opposed to total tree measurement. National Forest Administration aided substantially in conduct of the study, and our Washington Office aided in study planning and statistical analysis. The final report for general circulation will be completed in 1950.

B. Plans for 1950

The Station will strive to maintain a silvicultural and management research program which is in keeping with forest and watershed needs in the northern Rocky Mountain region, prepare and release research findings promptly, and offer counsel to forest managers in the field. Major investigative projects which will be worked on during the year include the following:

1. Complete final reports on growth in cut-over ponderosa pine and larch-Douglasfir types. These are important studies which are almost finished but have been set back by other urgent work. The reports will be of much value for predicting growth in timber stands where part of the trees are reserved at the time of logging. They will contribute to better forest management in the Columbia Basin region.

2. Re-employ Dr. T. S. Coile, forest soils specialist, and complete preliminary survey of forest soils problems.

3. Initiate local work in forest tree breeding, in cooperation with the Forest Genetics Institute at the California Forest and Range Experiment Station and Office of Blister Rust Control. This Station does not intend, nor would it be able with existing facilities, to undertake an active program of experimental breeding. But by making a special effort to keep informed of current progress and acting as an outpost for testing hybrid trees produced at the California Station, it can contribute to advancement of research and application.

4. Design and install improvement cutting demonstration experiments on farm woodlands in cooperation with Extension Service, Soil Conservation Service, and Washington State Division of Forestry. The cuttings will be conducted in eastern Washington and north Idaho, where farm woodlands generally have been cut too early and too heavily, with resulting losses in growth and earnings.

5. Test two new proposed methods of blister rust control on timber sales on Deception Creek Experimental Forest. These methods were developed by the Office of Blister Rust Control. Broadcast application of 2,4-D and 2,4,5-T by mechanical methods has opened new possibilities for wiping out the first heavy wave of ribes reproduction following timber cutting. The new proposals may permit going back to the formerly-used seed-tree method of cutting. The experiments will be handled cooperatively with the Coeur d'Alene National Forest and Office of Blister Rust Control.

6. Continue to experiment with control methods for pole blight and cooperate with other interested agencies. Additional opportunities for experimenting with cutting timber as a silvicultural control method will be searched for. Such operations will be conducted under regular timber sales and sale area betterment procedures.

7. Analyze the Station's numerous thinning experiments. When this analysis is completed, opportunities for a major report and closing of many thinning plots will be considered. The Station has thinning experiments which date back as far as 1914. For a good many years, there has been no attempt at a general analysis of the whole project, although individual experiments have been studied.

8. Promote tests of sample tree measurement on national forest timber sales.

9. Publish reports of research findings as rapidly as information becomes available. Written publications are one of the end products of organized research. Some reports require gathering data over periods of many years. In 1950, the Station plans to complete a considerable number of publications as shown in the following tabulation.

	Research Notes	Station Papers	Other	
White pine growth	1		1	
White pine management—				
Blister rust		1/ 1	1	
Ponderosa pine bibliography		1		
Ponderosa pine regeneration	3			
Ponderosa pine growth	1	1		
Larch regeneration	1		1	
Larch growth		1		
Sample tree measurement		1		
Costs and returns from pruning ...			1	
Tree poisoning	1		1	
Experimental forest guide books ..			2	
Miscellaneous	1		2	
Totals	8	5	9	22

1/ Revision of an earlier report, Station Paper No. 3, which was published first in 1940.

DIVISION OF FIRE RESEARCH

A. Accomplishments in 1949

1. During 1949 good progress was made in fuel classification studies. As a part of our fire control engineering research it is necessary to determine the specific influence of various fuels on the design of fire control systems. Proper classification of rate of spread and resistance to control in each fuel type is fundamental in determining the type, strength, and best location for fire detection and suppression forces, as well as in designing the communication, transportation, and service of supply for these forces. Fuel classification also is a basic factor in planning appropriate action on going fires. The progress made in fuel studies during 1949 will help in solving some of these fire control problems.

   The major emphasis in fuel studies, to date, has been on determining the effect of various fuel types on fire behavior. The results of this research show that fuel types have a major effect on the initial behavior of a fire, and that this effect must be reflected in designing the fire control system and planning action on the going fires. In fuels classified low and medium rate of spread, nearly 90 percent of the fires are only smoldering or creeping on arrival of the first suppression forces. On the other hand, nearly 20 percent of the fires in high fuels are running on the arrival of the first suppression forces. In extreme rate-of-spread fuels the initial behavior on over 65 percent of the fires is characterized by running or spotting.

   Studies were made of rate of spread in each fuel type in accordance with measured burning index variations. The results show the need for revisions in the fuel classification system so as to better identify very flashy fuels. In a study of 3000 specially selected fires it was found that nearly 20 percent of the fires in grass fuels will spread faster than 40 chains per hour. When the burning index is 70 or greater, rates of spread of 100 or more chains per hour are not unusual. These high rates exceed even the perimeter increase in the extreme fuel type which previously has been classified as the type giving the fastest spread.

   Another phase of the fuel study is to determine ignition rates in all timber and fuel types. It was found that the ignition rate in grand fir is over 400 fires per million

acres, or nearly double that of any other type. This very high ignition rate is due to two factors: first, very high lightning occurrence in that part of northern Idaho where grand fir is most prominent; and second, the large number of dead snags that is a characteristic of the grand fir type. Over 47 percent of the fires in grand fir were first ignited in a snag. Grass shows the second highest ignition rate with over 200 fires per million acres.

One of the significant parts of the research in fuel classification has been the determination of the over-all amount of fire business handled in each fuel type. During a nine-year period, 1936-1944, the total perimeter on nearly 11,000 fires amounted to over 219,000 chains. This is an annual average of over 300 miles of fire line. It was found that 38 percent of this perimeter was in medium rate-of-spread fuels, 25 percent in high, 22 percent in low, 14 percent in grass, and less than 1 percent in extreme fuels. These findings, coupled with similar studies of resistance to control, will aid greatly in designing fire control systems that are geared to the problem in each fuel type.

Progress in fuel classification studies was increased greatly through the detail to the Division of Fire Research of District Ranger George Fahnestock of the Gallatin National Forest. Much other valuable assistance was received from personnel in the Region 1 Division of Fire Control and field personnel on several national forests.

2. Continued progress was made in studying fire control requirements as related to expanded watershed conservation programs. To facilitate this study a regional map was constructed showing the area in each 1000-foot elevation zone on all of the upper watersheds of the Columbia and Missouri Rivers. With this map as a base, the occurrence, behavior, area burned, and control requirements were studied on over 20,000 fires. The results of this research will facilitate improved fire control planning in connection with river basin developments.

On the tributaries of the Columbia River in northern Idaho and western Montana special fire studies were made on 13,500,000 acres lying above an elevation of 4000 feet. On these upper watersheds fire occurrence is the highest of any zone in the region. On the Clearwater National Forest in northern Idaho lightning fire occurrence averages 177 fires per million acres on a 475,000-acre watershed lying between

5000 and 7000 feet. On the upper watersheds situated in national forests west of the Continental Divide the average annual perimeter of fires amounts to 15,000 chains. Thus the fire control organizations must be designed to handle an annual average of 187 miles of fire line on these important watersheds.

Fire studies on forested watersheds of the Missouri River also revealed important facts on the protection job. On the six eastern Montana national forests, 77 percent of the annual fire perimeter lies above 5000 feet. On upper watersheds lying between 6000 and 8000 feet the annual fire business calls for building 3300 chains of fire line. Identification of the most critical areas should enable the design of improved fire control systems for these slow-growing but highly valuable watershed forests.

3. Experiments were continued in the possibilities of dry-icing clouds as a lightning prevention measure. In 1948 preliminary investigations were made of this interesting possibility by Dr. Vincent J. Schaefer of the General Electric Research Laboratories. After working as a consultant to the Forest Service at the Priest River Experimental Forest, Schaefer recommended that experiments be made on the lightning storms that develop in that area. Accordingly, Gisborne made plans to study the development of lightning-generating clouds and also to seed appropriate clouds, using dry ice dropped from aircraft.

In the spring of 1949 a flight to test general dry-icing procedures was made in a C-47 aircraft in the vicinity of Missoula, Montana. On the basis of this test flight it was determined that the rigorous, high-altitude flying inherent in seeding experiments required that a more suitable aircraft be provided. Through the cooperation of the United States Air Force a B-29 bomber was made available at the Spokane Base of the Strategic Air Command. The excellent cooperation of the Air Force also enabled this B-29 to be equipped with a specially built dry-ice hopper and for daily radio communication to be maintained between the meteorologist at the Spokane Air Force Base and personnel at the Priest River Experimental Forest.

For six weeks during July and August personnel in the Air Force and the Experiment Station were prepared to make test dry-icing flights in the B-29. Gisborne maintained daily observations of cloud formations from the Looking Glass Lookout at Priest River. The test required two individual

lightning-producing clouds having identical characteristics. One of these was to be seeded with dry ice and the other to be observed as a check. Unfortunately, during this entire period these precise conditions did not materialize. Lightning storms were frequent, but they either came as strong fronts rather than individual clouds or at night when seeding and observation would be difficult.

The lack of suitable cloud conditions for test flights did not entirely halt progress on the project. Gisborne and the lookout observer at Looking Glass made detailed studies of cloud and lightning conditions. Lapse-time motion pictures were taken of the movement and development of clouds. Recordings of lightning strikes were made with a micro-ammeter loaned by the General Electric Company.

4. Work was continued on studies of aerial fire control. As explained in the 1947 and 1948 reports, progress has been made previously in aerial bombing of fires and in methods for mapping the seen area covered by planned aerial patrol routes. During 1949 the emphasis in aerial fire control research was on principles and methods of planning for the employment of aerial services on fires.

During the latter part of 1949 an analysis was started on all fires for the ten-year period 1940 through 1949 which have had smokejumper action either in initial attack or reinforcement stages. Maps are being prepared showing smokejumper fires on each national forest. When completed in 1950, this analysis should provide better information on which to plan future smokejumper operations. Progress to date has been made possible through the detail of several men from the smokejumper organization.

Studies were continued on aerial detection and combined air-ground detection planning. During the year field work was performed on aerial detection units now in operation. Observations were made of field operations, including consideration of when and where to fly, how often and how high to fly, and how to coordinate aerial and ground observations. At the end of the year plans were made to make a detailed study of air-ground detection during 1950 on the Flathead, Lolo, Lewis and Clark, Coeur d'Alene, and Helena National Forests. The objective of this study will be to determine required standards and methods for designing combined air-ground detection units.

5. Field studies of fire behavior were made on going fires. During August Barrows made fuel, detection, and weather studies on the disastrous Mann Gulch Fire on the Helena National Forest. Later, in October, Gisborne made additional studies on this same fire. While engaged in the strenuous field work connected with these studies, Gisborne met his untimely death due to a heart attack. He paid with his life on this fire just as did 12 smokejumpers and 1 smokechaser who made the initial attack. The tragedy of this fire and the loss of life by the men who fought and studied it serve as vivid reminders of the need for improved knowledge in the factors influencing fire behavior. As mentioned previously in this report, a major part of the fire research program at this Station is devoted to this activity.

6. Measurement and study of factors influencing burning index were continued at the Priest River Experimental Forest. Recordings were made of the moisture content and date of curing of yarrow, a plant which shows some promise of being a good indicator of the burning conditions in herbaceous vegetation. Studies were continued on the moisture content of large logs as an indicator of dangerous burning conditions. During 1949 the large logs reached the lowest fuel moisture rating since the experiment was started in 1943. The fire season of 1949 also was more severe than those of the past several years. To facilitate this study, a new set of large logs was prepared for use in 1950. In addition a new type of scale for weighing the logs was designed and manufactured. The new equipment will be used for the first time next year.

7. Fuel moisture sticks used in fire danger measurement stations throughout the West were manufactured at Priest River. During the year 1800 sets of oven-dried, ponderosa pine sticks were produced for use by all forest protective agencies west of the Mississippi River. Several improvements were made in the manufacturing system, including use of a new cleating hammer which speeds up assembly and better techniques for the oven-drying process.

B. Plans for 1950

1. The 1950 objectives include 10 major jobs as follows:

   a. Complete a manuscript entitled FOREST FIRES IN THE NORTHERN ROCKY MOUNTAINS. This will be a comprehensive report on the analysis of over 36,000 forest fires. It will contain four major sections with four chapters on the regional fire control problem, four on fire behavior, six on fire control action, and four on special factors. Completion is planned prior to the beginning of the field season.

b. Prepare revised descriptions for rate of spread in the fuel type classification system. Information gained from the analysis of fire reports points to the need for improved methods of fuel classification for use in designing fire control systems and planning action on going fires. The analysis also has provided some of the basic information needed in preparing revised classifications. It is planned to prepare a new fuel type mapping system for field testing on one or more national forests or other fire protection units.

c. An experimental model of an initial rate-of-spread calculator will be designed. This also capitalizes on information gained from the analysis of fire reports as well as several years of field work at the Priest River Experimental Forest. Its purpose will be to serve as a guide for field forces in calculating probable fire behavior in accordance with variations in topography, fuel type, and burning index.

d. The rate-of-spread calculator will be tested in the field on going fires. The first experimental model is based upon detailed study of thousands of fires. However, it will need intensive field testing and revision before it is ready for general use.

e. A detailed analysis will be made of air-ground detection units. This will be a continuation of work already started in an attempt to determine required standards and best techniques for designing detection systems. If funds are available, it is hoped to make field tests of lookout and aerial patrol efficiency.

f. Complete the analysis of smokejumper fires. This is an urgently needed job and should provide much basic information gained from 10 years' experience with smokejumper action on nearly 1000 fires.

g. Fire behavior and control observations will be continued on going fires. Definite plans will be made to observe at least two large fires in the western regions and other smaller fires as opportunity permits. Statistical analysis of thousands of fires has helped in determining several basic principles of fire behavior. Further studies in the field on going fires are needed in testing these principles.

h. Cooperate with the California Station and Regions 1 and 5 in the development of guide lines outlining fundamentals of fire behavior. A pooling of efforts and experience should help in developing much needed guides for field use. Barrows plans to visit California during the fire season to work with national forest and research personnel on going fires and to observe first-hand the methods used in evaluating fire behavior.

i. Continue Priest River studies on moisture content of herbaceous vegetation and large logs. The new set of large logs and the new weighing equipment will be put into service.

j. Continue manufacture of fuel moisture sticks for the western regions.

2. The fire research program remains out of balance with the most urgent needs and opportunities. From any approach to this region's fire job -- number of fires, dollars spent in control, the immense forest areas, value of the resources and especially water resources, the safety of men in fighting fires, or the total fire danger -- the magnitude of the research effort is far below the basic requirements. Fire research is the most meagerly financed and staffed of any Forest Service research activity. The objectives listed above for 1950 are only a small part of the research jobs that need action, and only a small-scale attack can be made on these few jobs. Fire research has proved through past efforts that it can save dollars and resources. These savings will be greater if the future program can be better balanced with the size, scope, and importance of the job.

A. Accomplishments in 1949

1. Stock fattening and digestibility studies of wood-sugar molasses were completed. Final results of studies conducted under the supervision of the Montana State College Experiment Station substantiate preliminary findings and establish the value of wood-sugar molasses. The steer fattening study was made up of four lots of ten yearling whiteface steers each. They were fed the following ration in the form of $\frac{1}{4}$" pellets for a period of 130 days at the Wine Glass Ranch located near Helmsville, Montana:

FEEDS	Lot I No. Molasses	Lot II Cane Molasses	Lot III Wood Molasses	LOT IV Wood Molasses
	%	%	%	%
Oats	28.0	23.6	22.1	24.7
Corn	20.0	16.9	15.7	17.7
Barley	32.0	27.0	25.3	28.3
Cane Molasses	---	10.0	---	---
Wood Molasses	---	---	11.0	7.0
Soybean meal	10.0	12.5	15.6	12.3
Alfalfa meal	8.3	8.3	8.6	8.3
Iodized salt	1.0	1.0	1.0	1.0
Bospro*	0.7	0.7	0.7	0.7

*Bospro is a commercial supplement containing vitamins A and D

The study was conducted under typical ranch conditions during extremely cold weather. Final conclusions as reported by the Montana State College Experimental Station were that the rations containing wood molasses were apparently as satisfactory as the rations containing cane molasses and/or the ration containing no molasses.

The lamb fattening and digestibility studies which were made at the State Agricultural Experiment Station consisted of four groups of 17 lambs each. The study was conducted for a period of 98 days during the fall and winter of 1948-49. The feed composition of the concentrated mixtures fed was as follows:

RATION NO.	I	II	III	IV
	%	%	%	%
Oats	60.0	50.0	50.0	55.0
Barley	40.0	33.3	33.3	36.7
Cane Molasses	---	16.7	---	---
Wood Molasses	---	---	16.7	8.3

The summary of results as reported by men in charge of the study was as follows: Lambs can be fed for a normal fattening period on rations containing wood molasses with no apparent ill effects on the health or well-being of the lambs.

2. Accelerated decay resistance study reveals that the basal outer heartwood is the most decay resistant portion of both western redcedar and western larch trees. Decay resistance becomes less as you proceed toward top of the tree. The drop-off is more pronounced in cedar than in western larch. Very little difference found in decay resistance of heartwood of western redcedar and western larch in the upper portion of the tree.

Rate of growth and age appeared to have little, if any, effect on natural durability. However, it is felt results regarding the effect of age should be checked further.

3. Survey of lumber dry kilns in the Northern Rocky Mountain area indicates need for small capacity kiln. Declining market for green or partially seasoned lumber has made it necessary for many small lumber producers to install kiln drying equipment.

The high cost of standard installations has caused many small operators to cut corners in their efforts to obtain cheaper dry kilns. This practice has created a condition favorable to the adoption of unproven and unsafe procedures.

Information developed in the survey shows that there is sufficient standard kiln drying capacity in the Northern Rocky Mountain area to dry 19,015 M bd.ft. of lumber per week, or approximately 55 percent of the total lumber production.

4. Mine guide laminating plant completes first year of production. The mine guide laminating plant that got under production early last year at the Anaconda Copper Mining Company's lumber mill at Bonner, Montana, had a successful year. The plant met production requirements as set by the mines at Butte and in so doing was able to iron out most of the "bugs" characteristic of a new development.

Production up to the present time has been made up entirely of clear western larch. The practice of placing the grain of the second and fourth laminations at 45 degrees to adjoining laminations in order to expose more end-grain has also been followed up to the present time. This construction involves some production difficulties and consideration is now being given to parallel construction. The company is also considering using inland Douglas-fir along with western larch and also incorporating lower grades in the construction.

5. Study of untreated western larch transmission pole line near Baker, Oregon indicates 45 year service life of poles above ground. At the request of the Northern Rocky Mountain Pole and Treating Association this larch pole line built in 1904 was inspected by Anderson and two members of the Association. A report now available at this Station shows that many of the original larch poles were still sufficiently sound to justify stubbing as late as 1946. The test mile of the line studied indicated that 80% of the poles were still in good or fair serviceable condition after 45 years.

6. A survey of air seasoning of transmission poles revealed archaic practices. Mathewson, physicist from the Madison Laboratory, and Anderson surveyed seasoning practices in 10 pole yards of the Northern Rocky Mountain area. The survey showed seasoning practices of round timbers are now at the same stage of development as lumber seasoning was 30 years ago, and that yards in the Spokane and north Idaho areas have settled on western larch along with western redcedar as major species while yards in Montana have settled on lodgepole pine as the major pole species.

7. Waste wood from pole shaving plants surveyed and recommendations made for profitable utilization of same. Cooperation of the Elmendorf Research Corporation of Chicago was enlisted during the year. Firms having surplus waste pole shavings furnished test material to this concern. Various kinds of building boards were made from this waste. The most promising one was a structural board made with Portland cement as a binder. Thus a development type of applied research may result in use of about 100 tons of waste produced daily by the pole industry.

8. The Forest Utilization Service participated in many other activities during the year. Correspondence again topped the 1000 mark. Major interest centered in Timber Conversion, Preservation and Chemistry of Wood. The remainder of the requests were fairly equally divided over all other activities. Over 100 members of the forest products industries called in person at the Forest Utilization Service office during 1949. Both Anderson and Mueller participated actively in the fourth annual Wood Products Clinic which centered on kiln drying. Anderson is a member of the board of directors. Numerous papers and talks on various phases of wood utilization were prepared and presented at meetings during the year. Meetings included the American Wood Preservers Association, Forest Products Research Society, Society of American Foresters, Washington-Idaho-Montana Dry Kiln Club, and Montana State Industrial Development Division.

B. Plans for 1950

Division personnel at the Station consists of two foresters of many years' experience in the field of forest products, and one secretary.

Most of the program is quite similar from year to year since long term objectives have been set up. Objectives and activities planned under them for the year 1950 are presented herewith. Priorities of work change somewhat from year to year but the following presentation is arranged on a priority basis as nearly as practicable.

1. Betterment of existing wood-using industries and development of new secondary wood-using industries. Our first concern is with existing industries. Small industry finds it especially difficult to keep abreast of current developments, hence we are planning the following work under this heading:

   a. Demonstration of Wyssen cable system of logging. This type of skidding originated in Switzerland and is claimed to be especially well adapted to skidding inaccessible timber in steep rocky country. We are arranging a demonstration in the Engelmann spruce type in the Kalispell country. Considerable success is claimed for preliminary tests in the Adirondack Mountains. The method may be a partial answer to the erosion problem encountered on steep slopes after conventional logging operations.

   b. Demonstration of new pulpwood harvesting equipment. A new pulpmill is now being constructed at Lewiston, Idaho. Others are proposed for north Idaho, western and eastern Montana. They will, no doubt, use small wood down to 100" lengths. This will be a new experience for Inland Empire loggers and they should profit from planned harvesting demonstrations.

2. Establishment of a pole and post industry that is compatible with forest management needs and integrated with existing cedar-pole and other wood-using industries. While the pole industry is an old timer in the Inland Empire the past five years have witnessed the introduction of new species, particularly western larch and lodgepole pine. Problems of harvesting, seasoning and treating of these species have arisen. To assist in the solution of these problems we are planning the following during the coming year:

   1. Assist the Madison Laboratory in a study of all air seasoning variables affecting the seasoning of western larch and lodgepole pine. Study plans will be drawn up by the Laboratory and the Forest Utilization Service will make arrangements for local manpower required to carry out the study.

2. Review cedar transmission pole service tests of the Chicago Milwaukee St.Paul & Pacific Railroad and Montana Power Company, and make results available to the pole industry. Many of these cedar poles have been in service now for 30 years or more and there should now be some indication of the total service life of the poles.

3. A building board has been experimentally made of pole shaving waste. Assistance will be given to those promoting the manufacture of this board by arranging tests of the mechanical and physical properties of this board and making surveys of available raw material.

3. Assist existing pulp and paper industry and encourage establishment of pulp mills in northern Idaho, western and eastern Montana. For years the Madison Laboratory and other institutions have made tests of Inland Empire woods to determine their suitability for pulp and paper making. To make this information available to interested individuals and agencies it is proposed to:

Prepare separate technical notes summarizing all recent information on lodgepole pine, Engelmann spruce, second growth ponderosa pine and western larch.

The Forest Utilization Service will also assist in an analysis of the practicability of a pulp mill in eastern Montana. This is part of a project being carried on by the Station Division of Economics.

4. Application of wood research results through cooperative relations with interested individuals and groups. The Forest Utilization Service is called upon by many individuals and groups to furnish technical assistance and counsel in wood utilization matters. Not all of these groups can be enumerated beforehand because requests for assistance are not always forseeable. Some of the groups we expect to work with during the coming year are:

1. Regional Administrative Organization, Forest Service. Contact with timber administrative forest officers is desirable. It is planned that the regional forester will schedule an FUS representative for at least two ranger meetings and two cooperative functional timber sale inspections during the year.

2. Washington-Idaho-Montana Kiln Club. Assistance will be given in arranging programs, particularly the annual joint meeting with the West Coast and California Clubs.

3. Forest Products Research Society. Activity on Board of Trustees and program development.

4. Northwest Wood Products Clinic. Activity on Board of Directors and program development.

5. Industrial Development Committee, Montana State Chamber of Commerce, and similar organizations. Activity on Board of Directors and program development.

6. Montana Resources & Development Board. Act as consultant in forest product matters.

7. Maintain committee memberships on American Standards Association and American Wood Preservers Association.

5. Establishment of a veneer and plywood industry in the Inland Empire using western larch and other local species. Much of the information on experimental work in this field is yet to be worked up into form usable by interested agencies. One important question that always comes up pertains to the influence upon lumber recoveries of diversion of logs from a sawmilling operation to peelers. During the year existing data on this subject will be written up and released as a technical paper. Data developed to date on the veneering of local species, including western larch, ponderosa pine and Engelmann spruce will also be written up and released as a technical paper of the Station.

6. Establishment of a wood-laminating industry to serve the needs of the region. A plant has already been established at Bonner. Continued cooperation with this company in the solution of technical operating problems is planned. Laminated mine guides now installed in the Butte mines will also be inspected.

7. Establishment of a chemical industry in the region using wood as a raw material. Three definite lines of work have been carried out in the past under this heading. They are (1) production and use of wood molasses, (2) chemical analysis of western larch, and (3) modification of western larch wood properties through chemical processes.

Experimental feeding of wood molasses by the Montana State College will continue. Arrangements have been tentatively made for delivery of approximately 12,000 gallons of wood molasses to points in Montana for experimental feeding of cattle and sheep under range conditions. Also about 10 tons of lignin (resulting from wood molasses manufacture) will be procured for neutralization of alkali soils experimental work in Montana.

A final report on the chemical analysis of larch wood from roots, stumps, dead fire-killed trees, tops and limbs will be prepared jointly with the Madison Laboratory.

FLOOD CONTROL SURVEYS

A. Accomplishments in 1949

1. Survey of Columbia River Watershed Is Undertaken. During the year the Department reconsidered its survey job in the Columbia Basin. As a result, it was decided to prepare a single report for the entire basin. Completion date was set for January 1, 1953. To this end, the first general organizational meeting was held in Seattle in October. At this meeting it was agreed that the exterior boundary of the basin and four major interior subdivisions would be identical with the delineations to be used in the Comprehensive Agricultural Plan. For flood control purposes, these four subdivisions were broken down further into 10-15 hydrological units. These units, in turn, were assigned to the various survey offices for study. Altogether there are five flood control survey offices working on the project, four are attached to Forest Service Experiment Stations (Northern Rocky Mountain, California, Pacific Northwest and Intermountain), and one to the Soil Conservation Service regional headquarters in Portland. In order to carry on the survey in an orderly fashion, the Pacific Northwest Station has been set up as the liaison office, and the survey chiefs and technicians from each office have been organized into technical committees.

   The survey area assigned to the Northern Rocky Mountain Station coincides fairly well with the regular Station territory; it includes all of western Montana, Idaho north of the Salmon-Clearwater divide, and northeast Washington east of the Sanpoil-Okanogan divide. Most of the work in 1949 was done in the Montana portion, but considerable planning and reconnaissance were undertaken in the other parts.

   Land use and classification studies were concentrated in the Clarks Fork drainage. Using Forest Survey data as a base, cover type maps were prepared for seven small mountain watersheds. During the field season these maps were used in a more detailed inventory in which supplementary information was secured on aspect, slope, elevation, specific cover composition and density, land use and soils. Depth, texture, drainage, erosion and occurrence of litter and humus were considered in the soil descriptions. Evidences of streambank cutting and erosion, and of road and trail wash or channeling were also noted. Field examination was completed on five of these small areas and partially completed on the other two.

As the season advanced, field reconnaissance was extended into the Idaho and Washington sections. By the end of the season, seven large sample watersheds were selected for more detailed land use studies, program development, and hydrological analysis. These are scattered throughout the area assigned to this Station. Work started immediately in plotting and arranging Forest Survey type, density, and condition classes within these watersheds. The earlier field work helped greatly in arranging logical and significantly different hydrological complexes. By the end of the year, cover data had been largely completed on one sample and a start had been made on another.

Mountain soils are very heterogeneous. Preliminary soils work shows that parent material is the greatest single factor determining soil characteristics. Due to a wide range in geological formations, the depth, texture, color, slope, pore space and other features of the forest soils vary widely within short distances. A tentative scheme has been worked out for grouping the soils in the seven sample watersheds into four broad categories. The grouping is necessarily very broad and will have to be refined and described more completely after field study. The four groups are: (1) soils derived from intrusive igneous rocks and related metamorphics, (2) soils derived from extrusive igneous rocks, (3) soils derived from sedimentary and related metamorphic rocks, and (4) soils derived from transported materials.

Several sets of soil moisture-temperature units have been installed on a cooperative basis at the Upper Columbia Snow Laboratory near Glacier National Park. Data from these units will supplement other soil studies.

Hydrological data are being collected. The scarcity of reliable streamflow and year-long weather records in the mountainous areas is a serious handicap to the flood control survey. Division work during the year has been aimed at supplementing and strengthening such data as are available to make them more usable, and at filling obvious gaps in selected areas.

Five staff stream gages have been installed and are now in operation. Four are on mountain streams, and one measures the stage of flow from a large spring.

One special snow course has been installed on the Deerlodge National Forest to sample mountain snow accumulation and melt

conditions at medium elevation in the open, and under light vegetative cover conditions.

A program of late-season readings at the regularly operated Soil Conservation Service snow courses, extending observations into the snow-melt period, is under way. Visual observations on rate of melt and change in snow conditions are being made by snow course operators.

Special topographic and cover surveys are being made of certain Soil Conservation Service snow courses so that individual sample points may be classified as to cover and aspect as well as elevation. Three courses were mapped by the end of the year.

Burned-area maps for the national forests have been completed and are to be used in connection with analysis of streamflow as influenced by large burned areas. Data and maps outside the national forests are not completed to date.

Preliminary plans have been developed for the engineering aspects of the survey but no time schedule has been prepared.

At present there is no economist within the division, but data on damage areas, flood plain history and similar information are being collected as time permits.

2. Advance Studies at Priest River Experimental Forest Are Continuing. Until early summer, personnel at the Experimental Forest were engaged in collecting data and taking measurements on snow accumulation and melt rates under various densities of cover, at a range in altitude, and on a variety of aspects. During the summer, some changes were made in the instrumentation and considerable time was spent in redesigning instrument supports and in improving the transportation routes for the next winter operation. A precipitation gage network was installed in the gaged portion of Benton Creek. Late in the year, Dr. Wilm of Portland and Mr. Osborne, Washington, met with Station representatives to review existing data; study operation, plans, and work load; and make recommendations for improving the studies. As a result, some late-season revisions were made in the project plans.

Although far from complete and conclusive, some very interesting figures were secured during the 1948-49 season.

Peak accumulation of snow (in equivalent inches of water), the approximate date of occurrence, and approximate date of end of snow melt for some of the snow courses in the timber and in adjacent cleared areas at the Priest River Experimental Forest - Benton Creek Watershed. 1/

Elevation	General Aspect	Cover	Maximum Snow Accumulation			Approx. Date Bare	Remarks
			Approx. Date	Water Content Inches	Timber Compared with Open		
2300	Level	Open	2/27	9.7	100%	4/8	---
2300	Level	Timbered	2/27	7.4	76%	4/25	Virgin forest area
2400	Level	Open	2/27	12.2	100%	4/12	---
2400	Level	Timbered	2/27	9.4	77%	4/16	30-year-old ponderosa pine plantation
3300	South	Open	3/1	12.0	100%	4/8	In gaged watershed near
3300	South	Timbered	3/1	8.3	69%	4/20	toe of slope
3300	North	Open	3/30	19.8	100%	5/4	In gaged watershed near
3300	North	Timbered	3/24	11.0	56%	5/10	toe of slope
3500	South	Open	3/1	10.9	100%	4/7	In gaged watershed mid-
3500	South	Timbered	3/1	7.9	72%	4/9	way up slope
3600	North	Open	3/30	22.0	100%	5/5	In gaged watershed mid-
3600	North	Timbered	3/30	13.2	60%	5/13	way up slope
3700	South	Open	3/1	13.8	100%	4/9	In gaged watershed near
3700	South	Timbered	3/1	8.2	59%	4/12	top of slope
4100	North	Open 2/	3/30	20.5	100%	5/12	In gaged watershed near
4100	North	Timbered	3/30	17.7	86%	5/7	top of slope
5500	South	Open	3/28	33.4	--	5/11	---
5500	North	Open	3/22	41.1	--	5/22	---

1/ Streamflow from the gaged portion of Benton Creek (the elevation of the gage is approximately 2600 feet) reached its peak on May 12. Lesser peaks occurred on April 20 and April 29. The maximum flow at Benton Springs (a high-elevation spring in the gaged portion of Benton Creek) probably occurred during the week of May 16-23.

2/ A few scattered trees in the open area may have had some affect on the snow accumulation and melt.

3. Other Activities of the Division Are Varied. Throughout the year the division has advised with National Forest Administration on watershed management and training programs. In anticipation of a Columbia Basin Comprehensive Plan, close contact has been maintained with National Forest Administration with respect to the progress and plans of the flood control survey. Membership has been placed on two subcommittees of the Montana-Missouri Basin Council of State and Federal Agencies. Many federal, state, and private individuals and groups have visited the Priest River area. The flood control program has been explained to other federal, state, and private individuals, including water engineers of private utilities; these contacts have resulted in exchange of information to our mutual benefit.

B. Plans for 1950

1. Survey of Columbia River To Be Continued. The major activity for 1950 will be continuation of the Columbia survey. Currently collected information will be analyzed and the maximum amount of additional data will be assembled.

Cover type maps for sample watersheds, now in various stages of construction, are planned for completion by the end of the year. Reconnaissance survey of the sample watersheds will be continued, making use of these maps. At the same time, evidence of stream-bank erosion and road or trail wash or channeling will be noted and studied by crews assigned to that work. A study of techniques and devices to measure crown densities is planned, the end result being the measurement of its effect on the accumulation and melting of snow as measured at our special snow courses at Priest River and at selected regular Soil Conservation Service snow courses. Correlation of work plans and procedures with other Stations working in the Columbia Basin is programmed for the early part of this year.

After preparing soil maps for the sample watersheds, field study is planned to secure descriptions of texture, depth, infiltration and water-carrying capacity and similar characteristics of the soil within broad classifications. It is hoped that data from the field will permit ready subdivision of the broad soil groupings into such units as will be needed in the hydrologic analysis of the sample watersheds. Final

work plans and procedures will be correlated with those of other crews working in the basin.

Supplemental readings at the regularly operated Soil Conservation Service snow courses, extending observations at selected courses into the melt period, will be continued, along with visual observations of snow melt and change in snow cover by snow course operators. More extensive observations will be made on an area-wide basis during the snow-melt period. Continued operation of the five installed stream-staff gages is planned. Two more special snow courses are to be installed and operated to further supplement the Priest River studies. Special topographic and cover mapping of selected Soil Conservation Service snow courses will continue. Completion of basin-wide burned area maps is expected before the end of the year. Analysis of streamflow from gaged watersheds containing large amounts of burned area will start soon after the first of the year. Current and continuing visual observation of streamflow and water quality will start with the spring breakup. Tentative work plans and outlines need be considered along with those of other Stations in the Columbia Basin. It is expected that they will be in final form by late spring.

Unless an economist is brought into the organization by July 1, a realignment of project assignments must be made to cover the activities of such a position. In the meantime, other personnel of the division will gather as much damage data as possible.

High priority has been given to the completion of the engineering work plan and outline for the Columbia Basin report. Properly correlated with plans and outlines of other Stations in the basin, these should be completed by summer, at which time field study of engineering phases of the project will start in select areas.

2. Advance Studies at Priest River Will Have High Priority. Until late spring, the major activity at Priest River will center around the completion of snow-sampling studies and observations on snow and soil moisture data, along with the continuing meteorological observations. Study and analysis of the records for the last two years is programmed for summer and fall.

3. Preparation of the Columbia Comprehensive Agricultural Plan Will Call for Close Cooperation. The division plans to work very closely with National Forest Administration and other

groups so that the flood control and comprehensive plan surveys can move along side-by-side. Close working arrangements will avoid duplication and will permit the preparation of harmonized and correlated final reports.

DIVISION OF WILDLIFE RESEARCH

(Wildlife research is conducted by the U.S. Fish and Wildlife Service in cooperation with the Northern Rocky Mountain Forest and Range Experiment Station.)

A. Accomplishments in 1949

1. Research on the effects of deer on ponderosa pine reproduction. The report of the 1946-47 field surveys on the Fisher River, Kootenai National Forest, was published in the Journal of Forestry (see Publications).

   Deer exclosures on Cow Creek and Richards Creek, Kootenai National Forest, were surveyed according to the annual plan. The annual progress report has been written. Outstanding development this year is the appearance of new volunteer conifer seedlings. This will be of great value in determining the fate of natural reproduction as contrasted with the studies of artificial plantings of the first two years.

   Artificial "browsing" of ponderosa pine seedlings in Rattlesnake Canyon was initiated in 1948 and continued this year. The purpose is to determine the effects of known intensities of browsing on growth and survival of the conifers. The project will continue for four to eight more years. The second annual progress report has been written.

2. DDT studies in 1947 in Idaho and Wyoming were published this year in the Journal of Wildlife Management (see Publications).

3. Small mammals in relation to reforestation were studied in three projects. The cooperative study with the Johns Hopkins "North American Census of Small Mammals" was continued at the Deception Creek Experimental Forest in Idaho and at Fivemile Creek, Kootenai National Forest, Montana. Throughout North America cooperators are checking on relative abundance of small mammals by the use of standardized trapping methods. The relative abundance of small mammals determines, in part, the survival rate of conifer seeds sown either artificially or naturally. The standardized evaluations of abundance are of value in accounting for success and failure in forest regeneration.

   The abundance of small mammals in relation to the abundance of naturally sown ponderosa pine seed is being studied also at Fivemile Creek. There, in addition to the Johns Hopkins study of small mammals populations, quantitative measurements are made of the annual seed production and survival. Stomach contents of

the small mammals are studied to determine which species consume ponderosa pine seed, and their relative rates of consumption. White-footed mice are the most abundant of the small mammals and also consume the most ponderosa pine seed. Chipmunks were the only other small mammals known to eat the pine seeds. This is the first time, so far as we know, that quantitative measurements have been made of the rate of seed production and survival, the abundance of small mammals, the relative preference for pine seeds of the different species, and their rate of consumption of the seeds. The mice and chipmunks were largely responsible for the destruction of approximately 90 percent of the naturally-sown seed.

The 1948 studies of pregermination and stratification of white pine seed at Blickensderfer Creek, Kaniksu National Forest, were repeated in 1949 by Experiment Station personnel. Assistance was contributed in evaluating species composition and abundance of the small mammals present.

4. The effects of porcupines on forests were studied on two research projects. The Forest Surveys of the Forest Economics Division collected data on damage by porcupines to forest trees on their survey plots in southwestern Montana and north central Idaho. These data are to be analyzed by the wildlife biologist.

With the assistance of Fletcher E. Newby, graduate in wildlife technology, Montana State University, the biologist surveyed the incidence of porcupine damage at 31 localities in Idaho, Montana, and Wyoming. The primary objective was to determine the chronology of damage. This was done by determining the age of porcupine scars by counting tree rings at the edges of the scars. By plotting frequency of scars over age on graphs it is possible to reconstruct the past trends in intensity of porcupine work. All localities showed histories of widely fluctuating intensity. It is proposed that timber managers can most economically control damage by porcupines by concentrating on porcupine control at times when the cycles are on the upswing, and releasing control pressure at other times. Data collected during the summer are being analyzed to determine relationships of damage outbreaks in one area to those in another. Local planning for control should cover areas over which the time and frequency of outbreaks are uniform.

5. Following the training in statistical methods last winter in Washington, D. C., there have been several opportunities to counsel other wildlife researchers on this subject. Many requests for such service have been received from Universities, State Fish and Game Departments, and Federal Wildlife Institutions. In addition to answering these requests, two papers have been written on statistical subjects. One paper, on the use of punch-cards in

wildlife research, is in press. It is being published as a Wildlife Leaflet by the U.S. Fish and Wildlife Service. The other paper is on confidence limits for the Petersen or Lincoln Index. It will be published in the Journal of Wildlife Management. Finally, a keysort punch-card bibliography of fish and wildlife is being designed and compiled. With less than $5 investment in equipment it will be possible to sort out in a few minutes all references on any vertebrate species, on any of 40 subjects, on any geographic locality, by any author. This will be done with a single set of cards - no duplicate files for cross-referencing are required.

6. Considerable effort has been expended toward public relations and conservation education. The biologist served as a member of the Blackfoot-Clearwater Game Range Advisory Committee and as chairman of its Research Sub-Committee. This committee is a citizens' advisory group sponsored by the Western Montana Fish and Game Association to advise with the State Department of Fish and Game on a wildlife conservation program for a recently acquired big game range near Missoula, Montana.

   The biologist served as chairman of the Education Committee of the Western Montana Fish and Game Association, and as committeeman on the Conservation Caravan Committee of the Montana Conservation Council. He was also elected First Vice-President of the Montana Academy of Sciences and Editor of that organization's publication. Numerous meetings of various organizations were attended. Addresses were delivered at some of them.

B. Plans for 1950

1. Regular annual field commitments will be met on the deer and small mammals studies.

2. There are much field data on porcupines to be analyzed and reported.

3. Manuscripts on the confidence limits and punch-cards will be carried through to publication. A Station Research Note will be published on small mammals in relation to natural reseeding of ponderosa pine. Another Note on a related subject will be published as junior author with Anthony E. Squillace of the Station.

4. The design of the punch card bibliography will be completed and work will start on assembling reference cards.

5. Statistical counseling, public relations, and conservation education will continue as in the past.

PUBLICATIONS

1. Issued During 1949

Adams, Lowell
Review of wildlife research on public lands in the northern rocky mountains. Processed. March 1949.

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The effects of deer on conifer reproduction in northwestern Montana. Jour. Forestry. November 1949.

_____, Hanavan, Mitchell G., Hosley, Neil W., and Johnston, David W.
The effects on fish, birds and mammals of DDT used in the control of forest insects in Idaho and Wyoming. Jour. Wildlife Management. Vol. 13, No. 3, pp. 245-254. July 1949.

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The condition of western larch poles in the Rock Creek-Baker, Oregon transmission line of the California Pacific Utilities Company. A report. December 1949.

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Lumber production tops 24-year record in northern region. Research Note No. 75. 5 pp. Stenalithed. December 1949.

Evanko, A. B.
There's many an IF in burning sagebrush. Montana Farmer-Stockman, June 15, 1949, page 8.

Gisborne, H. T.
Minimum rate fire insurance. Research Note No. 72. 4 pp. Stenalithed. April 1949.

Harris, G. A.
A selected bibliography on range management literature published in 1948. Vol. 1, No. 3, October 1949.

Hodge, W. C., Brown, C. W., and Finch, T. L.
Forest resources of southern Montana. Station Paper No. 20. 20 pp. Stenalithed. May 1949.

Huey, Ben M.
Christmas tree shipments increase. Research Note No. 71. 6 pp. Stenalithed. January 1949.

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Modern Christmas trees. American Forests, December 1949, pp. 10, 11, 34.

Hutchison, S. Blair, and Huey, Ben M.
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Forest resources of northeast Washington. Station Paper No. 21. 29 pp. Stenalithed. May 1949.

Mueller, L. A., and Wikstrom, J. H.
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Peterson, Roald A.
Manual for identifying soils from aerial photographs. Book review, Ecology, 30(3):401-402. July 1949.

Division of Range Research
Range Management and reseeding research. No. 8 in a series of 13-minute radio scripts developed for use in the "Your Natural Resources - The Lifeblood of Western Montana." 4 pp. Mimeo. January 1949.

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Range Research Hi-Lites (a review of Northern Rocky Mountain and other range research accomplishments designed to bring useful results to range managers and operators). Published monthly since May 1949.

Schaefer, Vincent J. (Collaborator with Northern Rocky Mountain Station)
The possibilities of modifying lightning storms in the northern rockies. Station Paper No. 19. 17 pp. Stenalithed. January 1949.

Tripp, Norman R., and Trimble, G. R., Jr.
Some effects of fire and cutting on forest soils in the lodgepole pine forests of the Northern Rocky Mountains. Jour. Forestry. August 1949.

Woolfolk, E. J.
Flight into sunshine. Book review. Scientific Monthly 68(3): 215. March 1949.

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Stocking northern great plains sheep range for sustained high production. USDA circular No. 804. 38 pp., illus. April 1949.

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Sagebrush isn't all bad - removal or killing requires careful planning. Montana Farmer-Stockman. July 15, 1949.

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Weight and gain of range calves as affected by rate of stocking. Montana State College Agricultural Experiment Station bulletin No. 463. 26 pp. August 1949.

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Birds of Concord. Book Review. Scientific Monthly, Vol. LXIX(4): 275. October 1949.

University of Idaho, School of Forestry; The Division of Forest Pathology, Bureau of Plant Industry, Soils and Agricultural Engineering, USDA; and Northern Rocky Mountain Forest and Range Experiment Station of the Forest Service, USDA
Pole blight - This is how to recognize it. Pamphlet. Stenalithed. December 1949.

2. Departmental Publications Planned for F. Y. 1950

Hurtt, L. C.
Managing northern Great Plains cattle range to minimize the effects of drought.

Short, L. R.
Reseeding to increase the yield of Montana range lands (revision and reprint Farmers' Bulletin #1924).

3. Departmental Publications Planned for F. Y. 1951

Division of Economics
The forest resources and industries of Montana.

Friedrich, C. A.
Reseeding formerly plowed range lands in central Montana.

Holscher, C. E.
Conservative forage utilization - a key to efficient cattle production.

Reed, M. J. and Peterson, R. A.
Response of cattle and range to stocking rate in the northern Great Plains.

4. Other Publications Planned for Release in 1950

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Consumption of ponderosa pine seed by small mammals. Station Research Note.

Boe, Kenneth N. (and Polk, R. Brooks)
Larch regeneration. Research Note and other paper. July 1950.

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Foiles, Marvin W.
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Lynch, Donald (and Chapman)
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Meik, E. E.
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Peterson, R. A.
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Pissot, H. J.
Cubic-foot/board-foot ratios. Research Note. October 1950.

Roe, Arthur L.
Larch growth. Station Paper. December 1950.

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Ponderosa pine growth. Station Paper and Research Note. December 1950.

Roe, Arthur L. and Squillace, A. E.
Can we induce prompt regeneration in selectively-cut ponderosa pine stands? Research Note 81. 7 pp. (Processed). March 1950.

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Plant heights as indicators of range condition.

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Dispersal and survival of seed in a partially-cut ponderosa pine stand. Research Note 79. 4 pp. (Processed). March 1950.

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Livestock production on crested wheatgrass reseeded range.

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Forest Utilization Service
The uses of western larch and chemical analysis of western larch. (To be prepared jointly with Forest Products Laboratory.)

The suitability of local species for veneer and plywood production. 3 Research Notes.

Influence of diversion of ponderosa pine and western larch peeler logs for veneer and plywood production on lumber recoveries. Station Paper.

Suitability of local species for the production of pulp and paper. 3 Research Notes.

PERSONNEL OF STATION - DECEMBER 31, 1949

OFFICE OF DIRECTOR

Charles L. Tebbe	Director
Mary J. Pershina	Administrative Assistant
S. Dagmar Nelson	Clerk
Marie Van Loon	File Clerk
Dorothy A. Peete	Clerk-stenographer

DIVISION OF FOREST MANAGEMENT RESEARCH

Russell K. LeBarron (Chief)	Forester (For. Man. Res.)
Grace D. Ehlers	Clerk-stenographer

DIVISION OF RANGE RESEARCH

E. Joseph Woolfolk (Chief)	Range Conservationist
Laurence R. Short	Range Conservationist
Roald A. Peterson	Range Conservationist
Merton J. Reed	Range Conservationist
Anthony B. Evanko	Range Conservationist
Mary C. Bowler	Clerk-stenographer

DIVISION OF FOREST ECONOMICS

Murlyn B. Dickerman (Chief)	Forest Economist
S. Blair Hutchison	Forest Economist
Paul D. Kemp	Forest Economist
Ben M. Huey	Forester (For. Man. Res.)
Thomas L. Finch	Forester (Mensuration)
William C. Hodge	Forester (Mensuration)
John H. Wikstrom	Research Forester
Melvin E. Metcalf	Forestry Aid (Research)
Henry J. Pissot	Forestry Aid (Research)
Monica E. Hobe	Clerk-stenographer

DIVISION OF FLOOD CONTROL SURVEYS

Martin E. Baudendistel (Chief)	Forester (For. Inf.)
Paul A. Ingebo	Hydrologist
Norman R. Tripp	Forester (For. Inf.)
C. Allan Friedrich	Forester (For. Inf.)
Austin E. Helmers	Forester (For. Inf.)
Gordon A. Hutton	Research Forester
Elwyn F. Peffer	Research Forester
DeWilton C. Smith	Research Forester
Lowell H. Belnap (died 1-31-50)	Soil Scientist
Onnolee A. Peffer	Clerk-stenographer

FOREST UTILIZATION SERVICE

Irvin V. Anderson (Chief)	Forester
Lincoln A. Mueller	Forester
Hilda C. Griffiths	Clerk-stenographer

DIVISION OF FOREST FIRE RESEARCH

Jack S. Barrows (Acting Chief)	Forester (Fire Res.)
Edna H. Campbell	Clerk-stenographer

INLAND EMPIRE RESEARCH CENTER

Charles A. Wellner (Research Center Leader)	Forester (Res. Adm.)
Grant A. Harris	Range Conservationist
Donald W. Lynch	Research Forester
Marvin W. Foiles	Research Forester
Richard F. Watt	Research Forester
Florence R. Olson	Clerk-stenographer
T. S. Buchanan (University of Idaho)	Collaborator

UPPER COLUMBIA RESEARCH CENTER

Arthur L. Roe (Project leader)	Forester (Silv.)
Kenneth N. Boe	Forester (Silv.)
Anthony E. Squillace	Forester (Silv.)

FIELD STATIONS

Deception Creek (Coeur d'Alene, Idaho) Marvin W. Foiles, In Charge; Richard F. Watt.
Priest River (Priest River, Idaho) Austin E. Helmers, In Charge; Albert W. Peiffer.
Coram (Coram, Montana) Anthony E. Squillace, In Charge.
Northern Great Plains (Miles City, Montana) Laurence R. Short, In Charge.
Vigilante (Alder, Montana) Anthony B. Evanko, In Charge.

FOREST PATHOLOGY (in cooperation with Division of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering): Lake S. Gill.

FOREST WILDLIFE (in cooperation with Fish and Wildlife Service, Department of Interior): Lowell W. Adams.

DIRECT AND INDIRECT COSTS BY FINANCIAL PROJECTS

F. Y. 1950

Financial Project	Indirect	Direct	Total
Forest & Range Management Inv.	$ 17,393	$136,058	$153,451
Forest Products Inv.	--	20,250	20,250
Forest Resources Investigations	6,940	53,460	60,400
Flood Control Surveys	9,000	73,745	82,745
Total	$33,333	$283,513	$316,846

DISTRIBUTION OF DIRECT COSTS BY MAIN PROJECTS

F. Y. 1950

Financial and work project	Cars maintenance & new	Equipment, misc.	Travel Expenses	Salaries		Total
				Regular	Temp.	
FOREST & RANGE MANAGEMENT INV.						
501	$ 833	$ 5,739	$ 5,415	$ 47,435	$ 7,700	$ 67,122
503	100	1,010	1,009	9,683	865	12,667
520	133	2,222	1,614	17,578	1,111	22,658
540	500	1,513	2,940	26,313	2,345	33,611
Total	1,566	10,484	10,978	101,009	12,021	136,058
FOREST PRODUCTS INV.						
FUS	200	760	1,500	17,790		20,250
FOREST RESOURCES INV.						
601	250	2,379	2,378	21,172	354	26,533
602	250	1,066	1,508	14,629	2,814	20,267
610		541	371	5,748		6,660
Total	500	3,986	4,257	41,549	3,168	53,460
FLOOD CONTROL SURVEYS						
701	533	16,230	5,000	47,834	4,148	73,745
Grand Total	2,799	31,460	21,735	208,182	19,337	283,513